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May 26, 2002

Wynchwood Park Trustees
c/o Dr. Donald Harrison
Senior Trustee
28 Wychwood Park
Toronto, Ont.
M6G 2V5

Re: **Wynchwood Park Pond Restoration**

Dear Trustees:

Thank you for inviting me to consult on the problems with the Wynchwood Park Pond and suggest some 'green' methods by which the aquatic environment may be cleaned up. My apologies for the significant delay in reporting back to you. I met on-site with Dr. Harrison on Thursday Nov 8, 2001 to inspect the pond and discuss the project history, concerns and actions taken to-date. The following brief summarizes the symptoms, diagnoses the problem and prescribes a series of methods or treatment options.

Symptoms

The artificial widening of the natural depression on Taddle Creek back in the late 1800's by Marmaduke Matthews made a lovely setting for a pond within the new artist's colony envisioned by the original owner of the ravine. For many years subsequent, the remnants of Taddle Creek had become increasingly stressed through urbanization of it's watershed, as portions were piped under the City. Due to the fixed water level, outlet structure and still waters, one result of the urban stressors was the gradual accumulation of silts and pollutants in Wynchwood Park Pond. It is a natural sediment trap and will continue to be so. Without intervention, over time, the pond would evolve, first into a marsh or swamp wetland, then into a wet meadow with a single thread watercourse running throughout. By the early 1990's silt accumulation was so significant that sediments could be seen just underneath the waters surface, ducks had to walk across the pond and it was starting the natural transition to wetland.

Figure 1 Excessive duckweed is an indicator of; a) an imbalance in the ecological processes as there are no grazers or "predators" of this plant to keep it's population in check, and b) abundant phosphorous present, upon which duckweed thrives.

In 1998, under the direction of Gartner Lee Associates Ltd. and the Wynchwood Park Trustees, the pond was dredged, the perimeter logs removed, storm drains improved and aquatic plants placed around the edge of the shoreline. Other restoration recommendations were made (ie. fish stocking) but it is unclear if they were fully implemented. I found the Gartner Lee documentation to be quite thorough, with quite valuable information on water quality, history and the source of contributing nutrients including ground water inputs.

Problem Diagnosis

Since the dredging, excessive algae, duckweed and the exotic plant "Water Lettuce" (*Pistia crassiseps*) have been occurring regularly in large masses to the disappointment of the Park community. This was clearfrom the photos sent to me and during the site walk of last November. Despite the imminent cold temperatures of the approaching winter, the volume of duckweed was quite significant as can be seen in Figure 1, taken on Nov 8, 2001.

Background data collected by Gartner Lee from 1997 and 2000 indicates Total Phosphorous (TP) in the water column was below 0.1 mg/L in March 200 following dredging, but well above the Provincial standard of 0.02 mg/L by September of that year, when it was 0.37 mg/L. Total nitrogenous compounds (Ammonia, Nitrate, Nitrite) show a doubling over the same period, but not a 20-fold increase as TP does. Phosphorous is the key metabolic nutrient in freshwater ecosystems and the supply of this element often regulates the productivity of natural waters. Most natural waters respond to additions of phosphorous with greater plant production.

The patterns shown in the Gartner Lee data are typical of post-dredge basins, where the vast majority of the phosphorous bound to the sediments is removed, exposing an acidic layer of mud at a very low pH (~4.5) where Phosphorous is in it's most available form, Orthophosphoric acid ($H_3PO_4^-$). The removal of the overlying sediments also reduces the acid-buffering capacity of the system as the naturally occurring Carbonates (CO_3, HCO_3^- and $H_2CO_3^{-2}$) that have built up over time are removed. At the same time, the slowly decomposing leaf litter that was suddenly exposed to oxygen - laden waters, quickly decomposes, rapidly releasing the Carbon as CO_2 (Carbon Dioxide) or CH_4 (methane) and Nitrogen as N_2 gas. Carbon Dioxide in water dissociates, through day-time photosynthesis, to form a weak carbolic acid that further lowers the pH, further liberating Phosphorous directly to the water column where it becomes available to algae and vascular plants such as duckweed. Until such time as the buffering capacity is restored and the mud pH increased, there will continue to be abrupt swings in the chemistry of the water column and boom and bust population explosions of the duckweed and algae. The biological component requires that there are strong, self reproducing populations of zooplankton, snails, invertebrates, small fish and large fish (ie. a complete, balanced ecosystem and food chain) for long term sustainability of the system.

While the Water Lettuce is a tropical nuisance, it remains unclear whether it will survive the cold winters of S. Ontario - this spring will tell that tale if it survives in Wynchwood Park Pond. Any occurrence of Water Lettuce should be eradicated immediately before it has a chance to spread outside of the watershed as it can be a considerable nuisance in waterways and should not be allowed to spread downstream.

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Recommendations

- A considerable concentration of Phosphorous occurs in the water column. Direct removal of the surface duckweed over time will result in an indirect reduction of the amount of Phosphorous available for plant growth.

    - Duckweed removal may be done directly, however it is quite labour intensive and will need to be done several times throughout the year. The duckweed may also be skimmed off by using the installed box, but in either case, it should be removed well away from the site so that the nutrients do not drain back into the pond once the duckweed decomposes. Harvesting should be done frequently - the more duckweed removed, the more it will grow and the more it will remove Phosphorous from the water column.

    - Collected duckweed makes an excellent soil conditioner in the garden as it breaks down quickly, releases the nutrients and makes N & P available for plant growth yet cannot survive in dry conditions. Once collected, it should be turned and aerated every two days for optimum composting - after 12 -14 days it could be made available to residents for their gardens. Even better, bag it and sell it at a local garden centre. If a community compost facility is being planned, composting duckweed will speed the composting time of your many tree leaves. Once harvested, try to look at the duckweed as a valuable resource rather than something to be disposed of.

- Orthophosphoric acid ($H_3PO_4^-$) and it's bio-available form, Orthophosphate (PO_4^-), at the water-mud interface of the pond bottom are the primary sources of Phosphorous in the upper water column. Phosphorous from lawn fertilization is undoubtedly entering the pond from surface water and groundwater but I suspect that these contributions are minimal compared to the source in the pond muds.

    - The acidity of the mud needs to be neutralized through an application of lime to shut down this source of Phosphorous and keep it bound up in the sediments and unavailable to plants. The most common liming materials are agricultural limestone $CaCO_3$ or $CaMg(CO_3)_2$, hydrated or slaked lime $Ca(OH)_2$ and unslaked or Quick lime CaO. Each differs in it's ability to neutralize acid. Agricultural limestone is the material of choice for increasing water pH as it is fine ground, but a coarser material may be better in this case as it is the bottom muds that need to be targeted. A water hardness of 20 mg/L or more is desirable.

    - If liming is to be done, the volume and type of material will need to be calculated based on the acidity of the mud plus the hardness (mg/L) of the water. Field samples at three sites in the pond are recommended, with mud cores of at least 25 cm depth preferred. We will also need to know the precise area, depth and volume of the pond so that the calculations will be accurate. Application rates vary from 100 - 7,000 Kg/ha of $CaCO_3$ equivalence and is highly dependent on the mud acidity.

    - Spreading lime is best done when the pond is dry so it can be directly incorporated into the mud. Assuming this is impractical in this case due to the groundwater inputs, the lime should be spread evenly over the surface from a boat or as a liquid spray. One application should be all that is necessary as the inflow / outflow and subsequent turnover rate is quite low. Liming can be done at any time of the year but is preferably done during winter or in the spring following the May rains.

  - Liming often has the result of producing large populations of zooplankton, which will graze on algae in the water column and in turn will provide food for fish and amphibians, which also consume large plants such as duckweed.

- Other biological control or "Green" methods of reducing the influence of Phosphorous on the system may be explored by the Wynchwood Park Trustees as follows:

  - Anchoring bales of barley straw into the inlet waters can be an effective treatment for control of filamentous algae - I am not sure if it will work with duckweed but it's worth a try. When immersed in water the straw begins to decompose. During this process a chemical is released which stops the growth of algae. First lignin's are released into the water, the oxygen in the water oxidizes the lignins into humic substances. When sunlight shines on the water containing the humic substances, hydrogen peroxide is formed. Hydrogen peroxide is known for stopping the growth of algae. The slow decomposition of the straw and sufficient sunlight ensure that an effective amount of hydrogen peroxide is continuously present for several weeks. [From www.barleybales.com].

  - Some of the Phosphorous contributions are due to fertilizer runoff from lawns in the Wynchwood Park area and from upstream sources. While on our walkabout, I could see that many of the residents had extensive gardens and trees rather than wide open expanses of lawn grasses requiring fertilizer for maintenance. Nonetheless, the community may want to get involved in reducing fertilizer use to protect the pond system. Where a healthy community and pond ecosystem is desirable, a reduction of residential pesticide and herbicide use would be appropriate objective, as those chemicals in runoff do impact the more sensitive species of the watershed, including people.

  - Introducing Muscovy Ducks (ie. Chinese Peking Duck) to the pond area may aid in removing duckweed as these birds will vigorously eat the plant as long as other food sources are not made available. This means that feeding of ducks (of any sort) should be prohibited for two reasons. First, ducks would prefer to be fed and will stop hunting for food given the chance. Secondly, feeding the birds (bread, lettuce, etc.) will provide other sources of nutrients going into the pond. Management of the birds on an annual basis may be troublesome as they will need good protection from the elements during the winter. They can protect themselves from local dogs & cats at other times and only need a simple structure to protect them from the elements during 9 months of the year.

  - Introduce a mixed population of fish species and eliminate the goldfish. The large goldfish will continue to stir the sediments of the bottom in search of food and make any other efforts at duckweed removal or liming pointless. A mixed population of largemouth bass, yellow perch, bluegill and sunfish as well as some of the coarser minnow species could be

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introduced to reintroduce a balanced food chain. Bottom consumers and grazers of algae and zooplankton as well as top level carnivores (bass) are necessary to complete the food chain. Many of these species, particularly the largemouth bass and bluegill will lurk under the surface and become an attractive amenity to the pond. The fish will also control the insect populations and work with the ducks to control the spread of duckweed. Fishing may be allowed, starting no sooner than two years after the stocking and it will be beneficial to remove the largest bass so that cannibalism is minimized.

Each of the above methods needs to be introduced in the spring before the duckweed has a chance to build up a large biomass and out pace the ability of the method to control growth. We recommend that the Trustees should consider liming the pond this year and begin to harvest and compost the excess duckweed in early June. Harvesting should be done at least monthly to be most effective, with the duckweed being composted at a site where the nutrients will be unable to flow back into the pond. The biological control options also have merit, but they will be somewhat slower to make the alterations necessary in the bio-chemical balance of Wynchwood Park Pond.

I trust these comments and recommendations will be useful to the Trustees in their on going management of the Pond. Once again, my apologies for the tardiness in delivering this brief. Please do not hesitate to call me at 905 450 3988 if I may be of further assistance or to clarify any point in the brief.

Sincerely,

HABITAT WORKS ! INC.

Association of Professional Biologists
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